STATE OF THE ART REVIEW

OF HUMAN-HUMAN COLLABORATION RESEARCH:

AN INTEGRATED, MULTIDISCIPLINARY PERSPECTIVE

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Scope of Literature Review

- Focus is on *Asynchronous (at different times) Distributed (in different places) Colla*
  -In ADC team members work together to solve problems in a relatively short period of time
  never actually meeting each other.
- Emphasis is on *cognitive aspects* of team members during ADC.

- Collaboration Literature is *very multi-disciplinary*.
  - This review represents a number of disciplines that impact ADC:
    - cognitive psychology
    - computer science
    - education
    - management and organizational behavior

  - Disciplines out of scope for review were:
    - sociology
    - anthropology
    - organizational small and large group behavior

- The significant ADC issues are discussed within the context of a *collaboration taxo*
  consist of the major elements for successful collaboration.
  - the elements in the taxonomy would be required for synchronous (at same
    distributed as well as asynchronous distributed collaborative teams.

Military Requirements for Collaboration

- Operations with Joint, Coalition, Non-Government and Volunteer Organizations
- Asynchronous and Distributed Command Level Decision Making
- Asymmetric Warfare
- Dealing with Open-Source (Uncertain, Conflicting, Partial, Non-Official) Data
- More Focus on Humanitarian Relief, Disaster Aid and Politically-charged Operations
- Rapidly Changing Team Members and Associated Org Structures
- Cultural Diversity Barriers
- Short Turn-Around, High Stakes, Crisis Driven Decisi
- More human interface with agents/automated system

Defense Policy Statements

- Joint Vision 2020
- Naval Transformation Roadmap
- FORCEnet
- DOD Information Management Strategic Plan (Information Superiority)

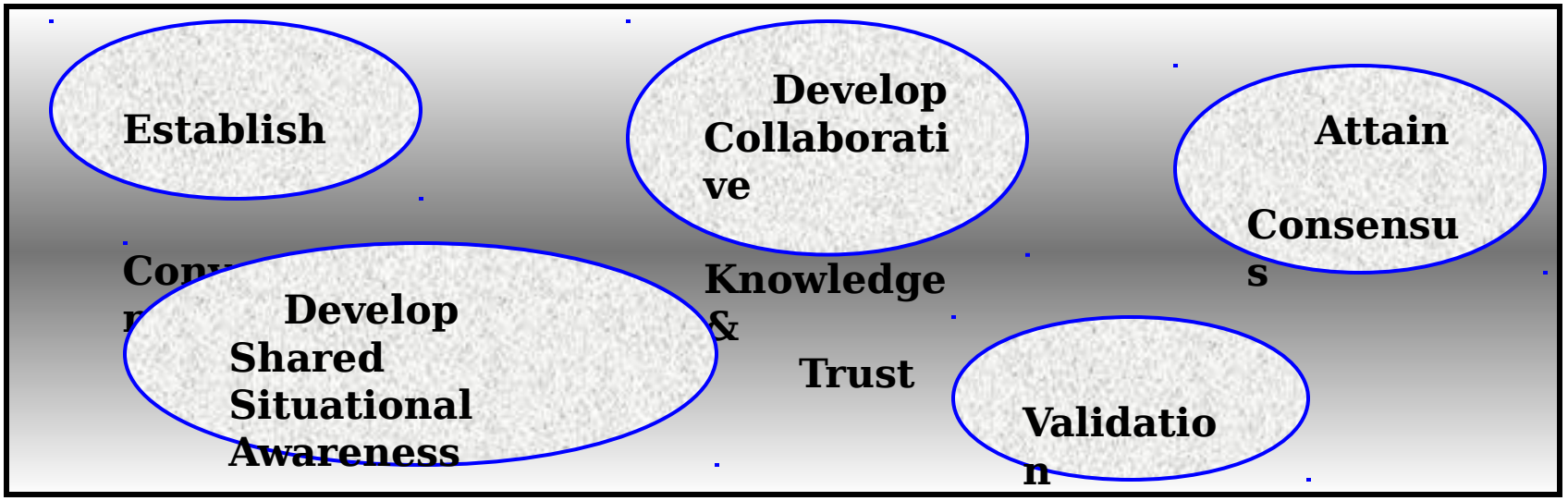
Some Examples

- International humanitarian relief effort
- Multinational response team in Afghanistan

Required Capability

- Integrated Collaboration Tools

A Taxonomy for Collaboration



• *Establishing conventions for communication* consists of the team developing rules for team behavior, terminologies and tools for consistent transfer of meaning, and individual mental model development.
• *Shared situational awareness and understanding* consists of the team coming to agreement with the facts of the situation, recognition of but not acceptance or resolution of differences or perspectives.
• *Collaborative Knowledge and Trust* consists of the team having a common understanding and agreement of corporate and individual goals and capabilities, being able to negotiate different perspectives resulting in deeper understanding of proposed solutions / actions, and development of trust between team members.
• *Attainment of consensus* consists the team identifying and negotiating differences and achieving a common outcome agreed to by the complete team.

•*Gaps in Understanding the Role of Communication and Establishing Conventions*:

(1) Identification of the major requirements for establishing effective communication.

(2) Determining the role of informal and formal communications in face-to-face and in ADC communications situations.

(3) Determining how face-to-face and ADC communications are alike (and therefore

•*Gaps in Developing Shared Situational Awareness and Understanding:*

(1) Development of collaborative computer supported tools that facilitate development of team shared mental models.

(2) Exploration of other environments to support collaboration. Whether communications based or virtual reality based, there is a need to determine the environmental requirements necessary to support the social interactions to develop effective collaboration.

(3) Development of metrics for measuring the team's shared mental representation. These metrics need to be incorporated into the computer supported tools that facilitate team shared representation.

Gaps/Areas for Future Research (continued)

- *Gaps in Developing Collaborative Knowledge and Trust:*

(1) Better quantitative methods for measuring team knowledge.

(2) Improve techniques for measuring dynamic shared understanding within a team.

(3) Identify the requirements for collocated teams to perform and develop shared understanding and trust. These requirements will aid in the requirements for computer support tools that facilitate shared understanding and trust in ADC teams.

- *Gaps in Attainment of Consensus:*

(1) Explanation of how individuals participate in team negotiation to reach consensus in an ADC environment.

(2) Identification and description of the cognitive processes used during team consensus building in an ADC environment. These cognitive elements would suggest areas for agent based support during ADC.

- *Gaps in Validation:*

(1) Identify the behavioral processes involved in dynamic team negotiation both face-to-face and in ADC (if available)(social psychology / sociology).

(2) Identification of tools for performing sensitivity analyses of team solutions (social psychology, business literature).

Representative Types of Collaboration Tools

Tool Capability	Synchronous/ Asynchronous	Features	Deficiencies
Instant Messaging	Synchronous	Development of "communities of practice"	Does not require appropriate checks/balances for higher level decisions
email	Asynchronous	Allows detail sharing of information	Uncertainty of communication, limited data sharing capability
Internet Relay Chat	Synchronous	Chat rooms	Maybe unwieldy to search
Voicemail	Asynchronous	Verbal communication is easier for participants	Uncertainty of communication
MUD (Multi User Dungeon)/MOO (MUD Object Oriented)	Synchronous	Creates a "meeting place"	Cumbersome to use
Project established web pages	Asynchronous/Synchronous	Forum for sharing information files	May have configuration control problems
BLOGs (Web logs)	Asynchronous	Create community, easy to use, supports large groups of users	
Vizard	Asynchronous	persistent visualization	In development

Representative Collaboration Tools

Tool Name	Manufacturer	Features
Electronic Notebook	Oak Ridge National Laboratory	Shared files, remote access, easy search, includes hyperlinks and hypermedia
SenseMaker	Stanford University	Uses multiple views of data
NetMeeting	Microsoft	Virtual synchronous meeting room with video capability and audio supplement
Exostar	Exostar, LLC	Electronic marketplace developed for aircraft manufacturers
Notes/Sametime	Lotus	Modular embedded components of line business tools (calendaring, email, chat, application sharing
Theatre Assessment Profiling System	Natural Selections, Inc.	Wargaming tool
Valuated State Space Collaborative Object Workspaces (COW)	Temple University (download)	Integrates multiple tools synchronously or asynchronously
Global Network	Raging Knowledge	Access expertise via inquiry response system
IP TEAM	NexPrise	Manages communication, documents, messages and supplier data
Collaboration Server	Stellent, Inc	Secure ad hoc online team work
V6 Multisite Content Manager	Vignette Corp	Multisite and portal creation tools
Interwoven 5	Interwoven Inc.	Content processing, collaboration, management, intelligence, production and distribution
Groove Workspace 2.1	Grove Networks, Inc	Desktop collaboration
Conference Center 2000	PlaceWare	Web conferencing, application sharing, whiteboarding
TeamFlow	CFM	Project management, document management
Centrae Meeting	Centra	Web conferencing, application sharing, whiteboarding, voiceover IP
Caucus Virtual Team	Caucus Systems	Project management, threaded discussion boards
CrossPad	A. T. Cross Co. (Cross Pen)	Combines regular paper and digital pen for data capture
Natural Writing Board	Pegasus Technologies	Captures standard marker inputs digitally

Glossary of Collaboration Terms

- *Cognitive Process*
- *Common Ground*
- *Computational Models*
- *Conceptual Models*
- *Consensus*
- *Data*
- *Data Visualization*
- *Decision*
- *Decision-Making*
- *Distributed Cognition*
- Heterogeneous Teams
- *Information*
- *Knowledge Building*
- *Knowledge Elicitation*
- *Knowledge Management*
- *Knowledge Structures*
- *Knowledge Visualization*
- *Open Source Data*
- *Situational Awareness*
- *Team Collaboration*
- *Transactive Memory*
- *Trust*

Additional Appendices

- *Centers of Excellence*
- *References & Bibliography by Topic Area*
- *Significant Publications & Conferences*
- *Conceptual Model of Collaboration*
  - Will discuss in detail as part of Thursday's group discussion